METHOD OF MAKING BROOMS

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

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By [Signature]
Our invention relates in general to a method of making such articles as brooms, brushes and the like and, more particularly, to a method of securing tufts of bristles to the handle, head, or the like, of such an article.

Considering terminology to be employed hereinafter, since, as suggested in the preceding paragraph, the method of our invention is applicable to the manufacture of articles of the type which includes brooms, brushes and the like, articles of this type will be referred to as brooms as a matter of convenience. The element of the broom to which tufts of bristles are to be secured will be referred to as the head of the broom. It being understood that the term "head" is intended to include the tuft-carrying element of any article of the type under consideration. Also, the term "tuft," as used hereinafter, is intended to include groups of bristles of various sizes and shapes.

A primary object of the present invention is to provide an improved method of securing a tuft of bristles of thermoplastic material in a cavity in a broom head.

More specifically, a primary object of the invention is to provide a method of securing a tuft of thermoplastic bristles in a cavity which involves fusing that end of the tuft which is inserted into the cavity so as to bond the bristles together and to anchor the tuft in the cavity.

An important object is to provide a method wherein the end of the tuft which is inserted into the cavity is heated electrically to a temperature at least equal to that at which the thermoplastic material becomes plastic so as to bond the bristles together and to anchor the tuft in the cavity.

Another object is to provide a method of fusing the tuft end in the cavity by resistance heating. Still another object is to provide a method of fusing the tuft end in the cavity by induction heating.

A further object of our invention is to provide a method which involves only local heating of the end of the tuft in the cavity.

The foregoing objects of our invention and the advantages suggested thereby, together with various other objects and advantages which will become apparent, may be attained through the employment of the exemplary embodiments of the invention which are illustrated in the accompanying drawing and which are described in detail hereinafter.

Referring to the drawing:

Fig. 1 is a side elevational view of a broom manufactured in accordance with the method of the invention;

Fig. 2 is an end elevational view of the broom illustrated in Fig. 1 of the drawing;

Figs. 3 and 4 are enlarged, fragmentary sectional views showing tufts of bristles inserted in cavities in a broom head. Fig. 3 showing the tufts of bristles before fusing and Fig. 4 showing the tufts after fusing;

Fig. 5 is a semidiagrammatic view illustrating an embodiment of the method of the invention which involves resistance heating; and

Figs. 6 and 7 are semidiagrammatic views illustrating embodiments of the method of the invention which involves induction heating.

Referring particularly to Figs. 1 and 2 of the drawing, we show a broom 18 which includes a head 11 having a handle 12 suitably connected thereto, tufts 13 of thermoplastic bristles 14 being secured to the head in accordance with the method of the invention. In the particular construction illustrated, the tufts 13 take the form of relatively thin sheets of bristles 14, although the tufts may have any configuration without departing from the spirit of the invention.

Referring particularly to Fig. 5 of the drawing, we show ends 18 of the tufts 13 inserted into cavities 17 in the broom head 11 prior to fusing of the tufts to anchor them in the cavities, the cavities being grooves in the particular construction illustrated to accommodate the particular configurations shown. In Fig. 4 of the drawing, we show the ends 18 of the tufts 13 as fused to bond the bristles 14 together within the cavity 17 and to anchor the tufts in the cavity. The method of fusing the ends 18 of the tufts will be considered in the following paragraphs.

Considering the method of the invention in more detail, we prefer, for reasons which will be discussed in more detail hereinafter, to employ for the broom head 11 a material which is non-conductive, or substantially non-conductive, electrically and which is substantially a non-conductor, or at least a poor conductor, of heat. After the cavities 17 of a size and shape corresponding to the size and shape of the tufts 13 have been formed in the broom head 11, we insert into each cavity an electrical conductor 18. The conductors 18 may take various forms. For example, the conductors 18 may be formed by placing in the cavities 17 powdered metal in sufficient quantities to form continuous electric current paths connecting the ends of the cavities. Alternatively, the walls of the cavities may be painted with a material which is capable of conducting electricity to form the conductors 18. However, as a matter of convenience, we prefer to employ conductors 18 having the form of pieces of wire which are placed in the cavities 17.

In accordance with the method of the invention, the conductors 18 are heated electrically to fuse the ends 18 of the tufts 13 to bond together those portions of the bristles 14 which form the ends 18 of the tufts and to anchor the tufts in the cavities. The conductors 18 may be heated electrically in various ways. For example, in Fig. 5 of the drawing, we show leads 19 connected to the opposite ends of the conductors 18, the leads 19 being adapted to be connected to a suitable source of electricity to effect resistance heating of the conductors, the latter acting as resistors. In Figs. 6 and 7 of the drawing,
we have illustrated inductive heating of the conductors 18. In Fig. 6, the broom head 11 having the tufts 13 inserted into the cavities 17 therein is shown placed in an induction furnace represented schematically by a coil 20 which may be connected to an alternating current source of suitable frequency. In Fig. 7, we show the broom head 11 with the tufts 13 inserted into the cavities 17 therein as placed in an induction furnace represented schematically by plates 21 10 which may be connected to a source of alternating current of suitable frequency. The broom heads 11 may be placed in the induction furnaces shown in Figs. 6 and 7 of the drawing one at a time, or may be moved continuously there- 15 through if desired.

The conductors 18 are heated in either of the foregoing ways to an extent and for a length of time sufficient to elevate the temperature of the tuft ends 16 to a value at least equal to that at which the thermoplastic material becomes softened or plastic. The temperatures at which various thermoplastic materials become plastic are well known in the art so that a recitation thereof herein is thought to be unnecessary. 25 When the tuft ends 16 have been heated sufficiently to render them plastic, the bristle ends forming the tuft ends 16 may be fused together to render the tuft ends substantially homogeneous, thereby bond- 30 ing the bristles 14 of each tuft together to form a substantially integral unit, which is a feature of the invention. Also, as the tuft ends 16 are fused by electrical heating of the conductors 18, the tuft ends are securely anchored in their cavities 17. We have found that the anchoring of the tuft ends 16 in the cavity 17 is apparently due to the fact that, as the tuft ends are fused, or plasticized, they tend to shorten axially of the tuft, as illustrated in Fig. 4 of the drawing, and to expand laterally of the tuft axes. Such lateral expansion of the tuft ends 16 results in their being firmly wedged in the cavities 17. In other words, such lateral expansion of the tuft ends results in the development of substantial normal forces at the interfaces between the tuft ends and the cavity walls so that the tufts are frictionally held in the cavities in a positive manner. We have found that when the tufts 13 are anchored in this manner, they cannot be withdrawn from the cavities 17 without applying thereto forces much larger than those which would normally be encountered during use of the broom 10. If desired, resistance to withdrawal of the tufts 13 may be further increased by undercutting the cavities, i.e., by making the cavities of lesser width at their outer ends than at their inner ends.

Presumably, the tendency of the tuft ends 16 to expand laterally when plasticized is due to the action of surface tension, although we do not wish to be bound by this theory. Although the method of the present invention is not limited to application to any particular thermoplastic material, it is preferable to employ for the bristles 14 thermoplastic materials suitable for the particular purpose for which the broom 10 is to be used. We have found that polystyrene, or copolymers of polystyrene, for example, are particularly suitable for bristles of a broom to be used for sweeping purposes, although other thermoplastic materials may be more desirable for bristles in brooms to be used for other purposes. For example, such thermoplastic materials as vinyl resins, cellulose plastics, and the like may be employed for the bristles 14, depending upon the use to which the broom 10 is to be put.

As previously indicated, we prefer to employ for the broom head 11 materials which are at least substantially nonconductive electrically and which are poor conductors of heat. The reason for preferring a material for the broom head which is substantially nonconductive electrically is to minimize the amount of electrical power required to fuse the bristle end 16. Also, the purpose of a material which is substantially nonconductive electrically and which is a poor conductor of heat is to insure that the tufts 13 will fuse only locally in the vicinities of the conductors 18. This further reduces the amount of electrical power required and also prevents fusing of and possible damage to the bristles 14 of the tufts exteriorly of the broom head 11. For example, wood, various plastic materials, and the like are among those which we prefer to employ for the broom head 11. However, in instances where the foregoing factors normally in favor of substantially nonconductive materials for the broom head may be disregarded, various conductive materials, such as metals, may be employed if desired.

It will be apparent that the present invention provides a simple method of securing tufts of bristles in cavities therein without the use of any fastening devices, such as clips, staples, or the like, which must be driven into the material of the broom head. Although we have disclosed exemplary embodiments of our invention for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in such embodiments without departing from the spirit of the invention.

We claim as our invention:

1. A method of securing a tuft of thermoplastic bristles to an element having a cavity therein, said thermoplastic bristles becoming plastic at a temperature lower than that required to alter the physical structure of said element, including the steps of: placing an electrical conductor in said cavity; placing an end of said tuft in said cavity; and electrically heating said conductor to elevate the temperature of said end of said tuft to a value at least equal to that at which those portions of said thermoplastic bristles which form said end of said tuft become plastic, whereby to bond said bristle portions together and to secure said end of said tuft in said cavity.

2. The method set forth in claim 1 wherein said electrical conductor comprises a resistor and wherein the step last defined comprises flowing an electric current through said resistor.

3. The method set forth in claim 1 wherein the step last defined comprises heating said conductor inductively.

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